MonPS35

Characterization of the 13.56-MHz CW Starter Plasma for the Pulsed, High Power 2-MHz Plasma of the SNS H^- Ion Source

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The H^- ion source of the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory is driven by up to 80-kW of 2-MHz RF in 1-ms long pulses at 60 Hz. The high power plasma is generated from a starter plasma that is maintained by continuous ~300-W 13.56-MHz RF, which is initially ignited with a H_2 pressure burst. The RFQ transmission improves with RF power, but requires low H_2 flows for thermal stability. To minimize the risk of plasma outages at low H_2 flows, the 13.56-MHz RF matching network was characterized over a broad range of its two tuning capacitors. The intensity of the plasma's emitted H-α line between the 60 Hz pulses of the 2-MHz RF as well as the reflected power of the 13.56-MHz RF were mapped against the capacitor settings. Optimal tunes for the maximum H-α intensity and for the minimum reflected power appear consistent. Low limits of the H_2 flow not causing plasma outages were explored within the range of the map. The tolerance of the 13.56-MHz RF matching against the influence of the high power 2-MHz RF during and after the pulse was studied for different power levels and matching tunes of the 13.56-MHz RF and for different H_2 gas flows.